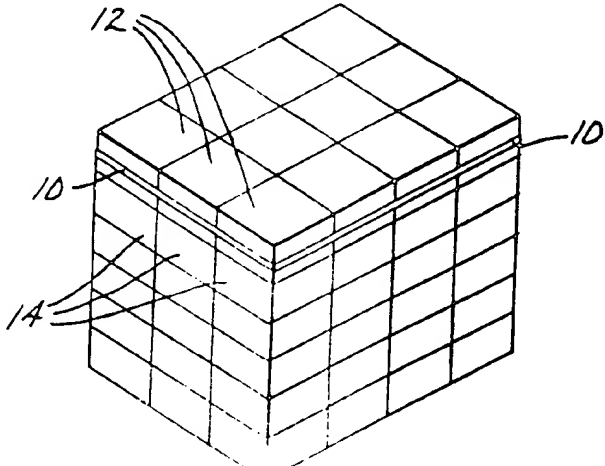




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(54) Title: METHOD OF UTILIZING PACKAGES BY MEANS OF A STRETCHABLE ADHESIVE TAPE		
		
(57) Abstract <p>This invention relates to means for securing objects together for storage, shipping, or other purposes. In many manufacturing plants, packages are at some point grouped with other or packages to facilitate handling, storage, and shipping. Such grouping is commonly referred to as "unitizing". Perhaps the most common form of unitizing is palletization. The major share of pallet stabilization is being accomplished with stretch wrap. It would be desirable to find a wrapping or strapping material that would avoid the following problems: (4) elimination of excessive amounts of waste material, e.g., used stretch wrap; (5) minimizing excessive looseness of strapping material, which results in movement of packages; and (6) minimizing excessive tightness of strapping material, which results in damaging packages. This invention provides means for unitizing objects, e.g., packages, through the use of a stretchable, packifiable, pressure-sensitive adhesive tape. The tape comprises a highly extensible, substantially non-recoverable backing bearing on at least one major surface thereon a layer of pressure-sensitive adhesive.</p>		

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METHOD OF UNITIZING PACKAGES BY MEANS
OF A STRETCHABLE ADHESIVE TAPE

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1. Field of the Invention

This invention relates to means for securing objects together for storage, shipping, or other purposes.

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2. Discussion of the Art

In many manufacturing plants, products or packages are at some point grouped with other products or packages to facilitate handling, storage, and shipping. Such grouping is commonly referred to as "unitizing". Perhaps the most common form of unitizing is palletization. As a specific facet of unitization, palletization becomes a process in which the unit load is joined with a pallet to provide for handling, primarily, with fork lift trucks. A palletized load must have vertical strength and horizontal or lateral stability. The stacking strength of a load (particularly loads of products packaged in cartons or containers) depends on the pattern or layout of each tier. For most cases, a column stack (one box directly on top of another) yields the greatest vertical strength. The column stack, however, has little lateral stability. Interlocking patterns increase lateral stability at some sacrifice in vertical strength. These patterns additionally can be used to optimize pallet space utilization. The end result of balancing vertical stacking strength, lateral stability, and space utilization can be an array of pallet patterns, requiring a different one for each product or package being palletized.

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Several equipment manufacturers have added a horizontal strapping section to their palletizers to

- 2 -

stabilize loads during the palletizing operation. Besides saving space, cutting labor costs, and simplifying handling, strapping during palletizing is also effective for stabilizing extremely unstable loads before they must be handled. Usually two or three strapping tiers will stabilize most loads, with many users strapping only the second layer from the top.

One means of providing lateral stability at low cost has been the use of adhesives to bond the layers of the load together. Adhesives for this purpose must have good shear strength to resist lateral forces that would cause a load to come apart. They must also have low tensile strength so that the load can be disassembled without damaging the product or package. Steel and, more recently, plastic strappings have been used for securing unitized and palletized loads. The plastics, e.g. polypropylene, nylon, and polyester, have replaced steel in enough applications so that now 80% of the strapping used for general palletizing is plastic. Of the plastics, polyester has been the most frequently used replacement for steel strapping, on account of the high breaking strength of the newer polyester products.

A few years ago, shrink wrapping of pallet loads generated considerable enthusiasm. While insuring load integrity, shrink wrapping also provided protection from dust, dirt, water, and pilferage. In more recent years, however, shrink wrapping has lost some of its initial appeal because of rising energy costs. The large ovens used to shrink the films around pallets have consumed too much energy and the resultant costs have caused shrink wrap to lose ground to the more energy-efficient stretch wrap.

The major barrier to shrink wrap stabilization is the energy required to shrink the wrap. The variety of shrink wrapping runs from hand-applied manual wrapping to automatic

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high-speed systems.

One area of unitization that is becoming more and more popular is bundling. Lumber, sheets of insulation, and bags of pet food have enjoyed successful bundling applications. Bundling has found application in a number of different industries, including the manufacture of lighting fixtures. Palletizing, unitizing, securing, wrapping, and bundling with strapping, adhesives, shrink wraps, or stretch wraps are activities common to nearly every packaging and shipping department.

It would be desirable to find a wrapping or strapping material that would avoid the following problems:

15

- (1) pull of fibers from the surface of containers on account of aggressive, sticky adhesives;
- (2) elimination of heating equipment needed to shrink wrapping material;
- 20 (3) elimination of additional mechanical devices to secure palletized loads, e.g., clips to join the ends of strapping material;
- 25 (4) elimination of excessive amounts of waste material, e.g., used stretch wrap;
- (5) minimizing excessive looseness of strapping material, which results in movement of packages;
- 30 (6) minimizing excessive tightness of strapping material, which results in damaging packages; and
- (7) prevention of circulation about the unitized load in order to minimize moisture accumulation.
- 35

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Summary of the Invention

This invention provides a means for unitizing objects, e.g., packages, through the use of a stretchable, detachifiable, pressure-sensitive adhesive tape. In the preferred embodiment, the tape comprises a highly extensible, substantially non-recoverable backing bearing on at least a major surface thereof a layer of pressure-sensitive adhesive. This tape has the dual capability of (1) being capable of being firmly bonded to a substrate (2) being detachified after being stretched.

In order to unitize a group of objects, a small portion of the tape, usually from a roll, is first applied to a first object. The tape, if in a roll, is then simultaneously wound around the object to induce detachification, and the remaining objects; finally, the tape is stretched around the group to anchor the tape. The tape can be easily removed merely by releasing the tape from the regions to which these portions are adhered.

The backing of the pressure-sensitive adhesive tape preferably has a Young's modulus of at least 2,500 psi (176 kg/cm²), more preferably at least 3,000 psi (211 kg/cm²), but less than 30,000 psi (2110 kg/cm²), most preferably between 5,000 psi (352 kg/cm²) and about 30,000 psi (2110 kg/cm²). The backing is elongated, a lengthwise elongation at break of at least 150%, more preferably at least 200%, and more preferably at least 300%. The backing has low elastic recovery, less than about 30% elongation recovery after being stretched up to its breaking point, and if the tape is to be used for unitizing a group of objects, a small portion of the tape, usually from a roll, is first applied to a first object. The tape, if in a roll, is then simultaneously wound around the object to induce detachification, and the remaining objects; finally, the tape is stretched around the group to anchor the tape. The tape can be easily removed merely by releasing the tape from the regions to which these portions are adhered.

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it will retain sufficient residual resiliency to apply tension to the load of unitized objects, i.e., in the manner of a large rubber band. Unlike a rubber band, however, the tape preferably exhibits a low degree of recovery. Tape having a relatively higher degree of recovery can be used if it is applied by power-driven machinery and if it does not tackify upon recovery.

The layer of pressure-sensitive adhesive of the tape has sufficient shear strength and adhesive holding power to adhere to small regions of the objects to which the tape is attached. The holding power of the adhesive to a substrate is preferably greater than the cohesion of the adhesive and less than the adhesion of the adhesive to the backing, so that the adhesive layer of the tape, when the backing is subjected to stress, will not separate from the backing. The adhesive layer is also preferably highly cohesive so that a portion of the tape can be peeled from a surface to which it is attached at an angle of less than 35° to the surface to which it is adhered.

The characteristic of the tape by means of which it adheres to the surface to which it is attached as permanent adhesion of the object upon removal of the tape that must be provided is important. The amount of tape that must be provided to provide sufficient area to constitute a relatively small portion of the total amount of tape required for application of the tape is important. The amount of tape that must be provided to provide sufficient area to constitute a relatively small portion of the total amount of tape required for application of the tape is important. The amount of tape that must be provided to provide sufficient area to constitute a relatively small portion of the total amount of tape required for application of the tape is important.

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packages and for securing bundles of loose articles, such as for example, rods and objects made of wood, metal, or fibrous materials. In effect, the tape can be used as a replacement for string, twine, or wire.

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Brief Description

FIG. 1 is a perspective view of packages arranged in tiers of stretchable, detachable adhesive tape wrapped around

FIG. 2 is a perspective view of packages arranged in the form of a stack of stretchable detackifiable adhesive tape wrapped around

FIG. 2a is a perspective view of a plurality of packages 15 a single strip of stretchable, pressure-sensitive adhesive 20 tiers of packages in a manner which minimizes the waste of material.

FIG. 3b is a perspective view of a plurality of packages shown in the arrangement rotated 90°.

FIG. 4a, 4b, and
25 illustrating now the details of the
method of this invention.

FIG. 5 is a plot of the output of the system and served by a tape store of this invention.

30

Detail

A tape suitable
described in the assignee's
35 Serial No. 1,000,173, is
However, together with the
suitable for the method
tape 1 comprises a base

The Drawings

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... a single strip
...-sensitive
... of packages.

of a plurality
g a single strip
-sensitive
of packages.

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operates in the

of a box closed
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Application
20, 1990.
ar tape are
ion. In general,
on at least one

major surface thereof a layer of adhesive. The major surface of the layer of pressure-sensitive adhesive can optionally bear a layer of low-adhesive composition.

Materials suitable for the backing of the highly extensible tape useful in this invention include polymeric sheet materials having high tensile strength (D) a lengthwise tensile strength at break of from about 50 to about 1,500 psi (3.4 to about 103 kg/cm²), more preferably about 800% to about 1,500% elongation at break, more preferably about 800% still more preferably about 800%; substantial elongation at break, preferably having less than about 10% permanent set after being stretched, more preferably about 5% or less, still more preferably about 2% or less elastic recovery; and a tensile modulus of at least about 3,500 psi (241 kg/cm²), more preferably about 3,000 psi (211 kg/cm²), most preferably about 2,000 psi (138 kg/cm²) and a tensile modulus of at least about 100,000 psi (6.9 kg/cm²). A suitable method for measuring the tensile properties of a material is described in Standard Test Methods for Plastic Sheet and Film, ASTM D882-88, "Tensile Properties of Thin Plastic Sheet and Film". If the tensile modulus is too low, the material becomes unsuitable for the backing of the tape.

Representative materials suitable for the backing of the tape include polyolefins, such as high density polyethylene, low density polyethylene, polypropylene, copolymers of ethylene with propylene, butylene, hexene, octene, decene, dodecene, tetradecene, hexadecene, octadecene, and eicosene; plasticized polyolefins; olefin copolymers, copolymers of ethylene with acrylonitrile, vinylidene fluoride, vinylidene chloride, ethylene, and

pressure-sensitive adhesive not bearing a layer of low-adhesive composition. The backing of the highly extensible tape useful in this invention includes polymeric sheet materials having high tensile strength at break of from about 150 to about 1,500 psi (10.3 to about 103 kg/cm²), preferably about 800% to about 1,500% elongation at break, preferably about 800% still more preferably about 800%; substantial elongation at break, preferably having less than about 10% permanent set after being stretched, more preferably about 5% or less, still more preferably about 2% or less elastic recovery; and a tensile modulus of at least about 100,000 psi (6.9 kg/cm²). A suitable method for measuring the tensile properties of a material is described in Standard Test Methods for Plastic Sheet and Film, ASTM D882-88, "Tensile Properties of Thin Plastic Sheet and Film". If the tensile modulus is too low, the material becomes unsuitable for the backing of the tape.

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copolymers and combinations of the foregoing. Mixtures or blends of any plastic or plastic and elastomeric materials such as polypropylene/polyethylene, polyurethane/polyolefin, polyurethane/polycarbonate, polyurethane/polyester, can also be used. Backings are typically in the form of single or multi-layer films. Backings are preferably selected from polyethylene and polypropylene films, with the most preferred materials being linear low density and ultra low density polyethylene films. Backings can be made by any known method of film forming, such as, for example, extrusion, co-extrusion, solvent casting, foaming, non-woven technology, etc. The backing can have any thickness as long as it possesses sufficient integrity to be processable and preferably ranging from 10 micrometers to 750 micrometers. Backings about 10 micrometers thick are preferred for aggressive adhesives. Backings about 750 micrometers thick are preferred for stretching forces that are higher than 4, thereby making applications more difficult, except for power driven machines.

The adhesive layer can comprise any pressure-sensitive adhesive, with particular adhesion being preferred. The use of adhesives, with generally increasing force of adhesion, ranging from about 4 N/dm to about 100 N/dm, is preferred. According to PSTC-1 and PSTC-3 (ASTM Designation D2003-1), a peel rate of 12.7 cm/min.

The adhesive is suitable for this in particular includes natural rubber, polybutadiene, polyisoprene, and styrene-butadiene copolymers, such as polyisoprene, polybutadiene, styrene-butadiene copolymers, and

other elastomers; and tackified or untackified acrylic adhesives, such as copolymers of isooctylacrylate and acrylic acid, which can be polymerized by radiation, solution, suspension, or emulsion techniques. The most preferred adhesives are tackified block copolymers. For some purposes, adhesives that are incapable of providing enhanced adhesion over time are desired, so that removal of the tape by peeling at a less than optimum angle will not grossly deface the package.

The thickness of the adhesive layer can range from about 15 micrometers to 1,000 micrometers, preferably from about 10 micrometers to about 400 micrometers. In this range of thicknesses, the thinner layers will peel more easily than will the thicker layers. Also, the dry coating weight of the adhesive in the adhesive layer can range from about 1/2 gram/24 sq. in. to about 50 grams/24 sq. in. (0.021 grams/sq. in. to 2.08 grams/sq. in.).

As the tape is peeled, the adhesive must detach from the surface. As used herein, "detackification" means reduction of the adhesive residue as measured by the Pressure-Sensitive Adhesive Test will be described in detail in the following. As a practical matter, upon stretching, tack is reduced by at least 10%, more preferably by at least 20%, and more preferably by at least 50%. It is noted that the adhesive is tackified, and the dry weight of the adhesive is increased. Surprisingly, the adhesive would have been expected to have a dry weight per unit area of the adhesive layer produced by any conventional means. For example, the adhesive is not tackified, and the dry weight per unit area of the adhesive is not increased.

backing, which can be then later eliminated in order to improve adhesion of the backing to the coating. The backing can be treated in the following ways: flame treatment, electrical radiation, acid etch pretreatment can be used. reactive groups such as hydroxyl, carboxyl, other reactive species, discharge pretreatment, polymerization, etc. If it is a roll, it is preferred that the backing be treated with a layer of low-adhesion material to allow for easy removal of pressure sensitive release material. Low adhesion suitable for the selected application. For example, see U.S. Pat. 4,279,771 and 4,279,772. In one embodiment, as shown in FIG. 1, the tape objects are placed more than one object in a row. In another embodiment, as shown in FIG. 2, the tape objects are placed more than one object in a row and a second layer of wrapper material is applied.

the layer and in some cases, in the layer to the prior to the one or more of plasma discharge, ultraviolet light. Such treatment can be without as acrylate, or light. Corona treated if a

tape from a side of the adhesive bearing thereon, the layer is treated with a position. The position can be as, for example, 2,532,011; 2,815.

as, as shown in a tier of objects on one or more. This simple method is useful for short distance

it, as shown in a tier of objects on one or more and the can be optional

retaining some of its effect, the tape acts as a band. However, the recovery of a rubber is with-
 5 include the pallet can be wrapped around the pallet bearing the detail
 10 tape allows the tape without damaging the also been found that the tensile strength
 15 seen how the tape 60 pressure sensitive stretches without premature If less than 45° from
 20 the portion of the object 66 will remain will not be pulled at an angle the horizontal,
 25 tape 60 adhered to detaching and the adhered surface angle of greater in FIG. the
 30 surface will tape 60 is removed. Alternatively, the sufficient care removing the the
 35 the tape adhered to the group of objects of shrink wrap

properties. In are a large rubber exhibits much less

this invention to t, i.e., the tape s to be stored and

characteristic of the from the objects objects. It has Tape also increases

and 4c, it can be 62 and a layer of e pulled and object 66 led at an angle of s shown in FIG. 4a, o surface 68 of the on of the tape 60 . If the tape 60 is ° to about 45° from the portion of the ot significantly e 60 will remain 60 is pulled at an horizontal, as shown 60 adhered to e portion of the ce 68.

can exercise tape without ect the portion of

d to unitize a s than the amount red to unitize

those objects. An
 disposal gener
 the met
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 5 if they not d
 tiers of pallet
 the met
 to wrap secu
 with the tape 72
 10 5, a small piece
 adhered to surfa
 tape 72. When
 shown) an simult
 portion of the
 15 point 1 of the
 it is wrapped ar
 After the box 70
 78 of the tape 7
 portion of attac
 20 the tape 72 arou
 adhesio between
 only at points X
 from the box 70.
 box is wrapped
 25 configurations
 used to secure
 other
 herein include
 a
 30 automot. areas
 necessary to co
 to be wrapped
 can be used to
 Typical stre
 35 rate, 10
 is need
 to
 wind a

solid waste requiring
 ion can be used to
 r other objects even
 d in a plurality of
 platform.
 ion can also be used
 e.g., a box 70,
 Referring to FIG.
 as from a roll, is
 at point X. The
 the roll (not
 to detackify the
 to the box 70 at
 tape 72 is unwound,
 as to close it.
 ed, a small portion
 et stretched. This
 to point Y to secure
 e. Significant
 a box 70 is obtained
 pe 72 is removed
 al damage to the
 trapping
 in FIG. 5 can be
 boxes.
 e tape described
 insulating.
 s, e.g., in the
 , as it is
 es of the surface
 etching capability
 conformity.
 at a fairly low
 es where conformity
 apes can be used to
 that is to be

connected to a second
polytetrafluoroethy-
lene can be used to gener-
ate sealing of the third
5 for low voltage
stretchable tape of
purpose.

Another object of
this invention is to
10 by stretching and
about the cables in
adhesion
stretchable area of
specifying the degree
15 the appropriate area
while not
as the area of previous
bearing surfaces of
thereof is also a
20 invention.

The following
illustrate the method

25 Pressure Positive
one
adhered to in an
A stainless steel
test probe (PE) (0.5
30 diameter) is raised
ring at speed
with the adhesive
of one end, the
adhesive being
35 to separate the
is measured and
test probe is

method of employing a
the stretchable tape
in layer for the

in applications, the
for insulation

on for the tape of
a plurality of cables
of this invention
operation.

An object in the
controlled by
or by specifying

any useful functions
tapes having backings
major surfaces
method of this

examples further
invention.

tip of the tape is
weight of 78.5 g.
a polyethylene
78 inch [0.95 cm] in
diameter of the annular
into contact
after a dwell time
d from the
minimum force needed
five-bearing surface
details of this
in D2979-82.

180° Peel Adhesion

- A sample (2.54 cm wide by 10 cm long) is adhered to a test panel having dimensions (5.08 cm wide by 1/16 inch 0.159 cm) so that 17.8 cm of the sample is in each direction of the sample of the panel. The portion of the panel is of the tester. The end of the sample is to form a tab. The rate of the sample is rate of in/min.
- 20 value being noted. The set forth in "Tensile Tapes" by Assurance- Illinois with B.

25 180° Peel Adhesion

- This is the 180° Peel test, Mosinee Paper Corp., Mosinee, Wisconsin.
- 30 surface of the sample by means of a

180° Peel Adhesion

- This is the 180° Peel test, a two inch wide (0.41 inch thick) material.
- 35 180° Peel test

Steel

- dimensions one inch (25.4 to 30.5 cm) steel (AISI 302 or 304) of at least two inches long (12.7 cm) by the centerline of the even inches (12.7 to extend beyond the edge tape is rolled once a roller. An end of the test with the test approximately one inch test panel. The end of jaw of the tensile tape is doubled over into the upper jaw and separated at a average adhesion. The results of this test are more-sensitive, Gil, Glenview,

the same way as the the test surface is Mosinee Paper to the entire steel test panel

at

the same way as the the test surface is by 0.165 inch Corrugated Box the lengthwise direction.

Mechanical Handling

- boxes of
dimension 10 1/2
(31.8cm) 15 1/2
5 to 15 p. n. (5.4
stacked 11 thru
on a standard 42
pallet. The proj
with forks can en
10 i.e., from back
truck equipped wi
and transport the
course at a walki
(152.4 m/sec).
15 to 11 m. (11
90° turn. The
pallets are low ad
in direction of
e.g., from and to
20 test are run for

Vibration Test

- unit
Mechanical Handling
25 onto a vibration
Machine consists
that distribute
throughout a plate
only vertically
30 and amplitude of
controllable, as
break. The
frequency starts
and then back to
35 acceleration 1.
details of this
D3582-9.

feet and having the
12 1/2 inches
and containing 12
d for dunnage were
box configuration
1 inch (121.9 cm)
truck equipped
any direction,
side. Using a lift
engages, lifts,
-shaped test
d five ft/sec
rise includes a 10
e aisle with a
ion zone. The
n and are tested
o each other,
l details on this
D1083-88.

ed in the
test was loaded
vibration Test
test surface
uniformly
s driven to move
The frequency
le,
ceptable
sweep of
eping to 100 Hz.
eeps were run at
Additional
STM Designation

A series of tapes based pressure-sensitive adhesives were prepared to illustrate the effect of various fiber pull from the materials. Each tape consisted of coating one major surface of a low density polyethylene substrate with a tackified pressure-sensitive adhesive. The adhesive was a styrene-isoprene ("Kraton" 1107) tackified with a carbon resin ("Wingtack Extra").

The formulation of this example was similar to that in U.S. Patent No. 3,239,478, incorporated by reference, and is as follows:

	<u>Ingredient</u>	<u>Amount (phr)</u>
20	Styrene-isoprene block copolymer 1107, Shell	100
25	Hydrocarbon resin ("Wingtack Extra", Goodyear Tire & Rubber Co.)	100
	Antioxidant Ciba-Geigy	1.5
30	Antioxidant American Cyanamid	1.5

The low adhesion backing was a copolymer of vinyl N-vinylacetate, which was described in U.S. Patent No. 2,532,011.

The backing composition was applied to the major surfaces thereof. The composition was applied to the backing not bearing the adhesive of each of the tapes of the series,

including a block copolymer composition were applied to various surfaces, including various packaging surfaces. The adhesive was prepared by coating one major surface of a 0.013 cm linear density polyethylene substrate with a tackified pressure-sensitive adhesive. The adhesive was a styrene-isoprene block copolymer ("Kraton" 1107) tackified with a carbon resin ("Wingtack Extra").

The adhesive of this example is described in U.S. Patent No. 3,239,478, incorporated by reference, and is as follows:

	<u>Ingredient</u>	<u>Amount (phr)</u>
	Styrene-isoprene block copolymer 1107, Shell	100
	Hydrocarbon resin ("Wingtack Extra", Goodyear Tire & Rubber Co.)	100
	Antioxidant Ciba-Geigy	1.5
	Antioxidant American Cyanamid	1.5

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1. The tape exhibited 7
by hand.

tion when stretched

5	Sample no.	Coating (unstretched)	Coating weight (stretched)
	1	0.014	0.014
	2	0.015	0.015
	3	0.020	0.020
	4	0.022	0.022
10	5	0.036	0.036
	6	0.043	0.043

The data in Table 1 indicate
15 ultimate yield can give
(approximately) in adhesion
area. The reduction in
increase in the surface
reduction results in a
20 Adhesion, in
is set forth in Table

stretching to
is reduction
weight per unit
to result from an
backing. This
tack and adhesion.
corrugated paperboard

Table 2

Sample no.	Adhesion (g/cm)		Fiber pull (%)	
	(unstretched)	(stretched)	(unstretched)	(stretched)
1	182.1	11.2	100	0
2	197.7	41.3	100	0
3	237.9	67.0	100	0
4	220.1	78.2	100	0
5	203.9	119.5	100	0

- 20 -

Pressure-sensitive tack, in g/0.645 cm², is set forth in Table 3.

- 21 -

Table 3

<u>Sample no.</u>	<u>Tack - SS probe (g/0.645 cm²)</u>		<u>Tack - PE probe (g/0.645 cm²)</u>	
	<u>(unstretched)</u>	<u>(stretched)</u>	<u>(unstretched)</u>	<u>(stretched)</u>
1	1319	276	909	125
2	1381	494	977	301
3	1832	793	1273	254
4	2048	813	1424	370
5	2232	1210	1645	319
6	2156	969	1501	269

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In Table 4, both adhesion to the surface of fiberboard and fiber pull from the surface of fiberboard are set forth for the tape.

Table 4

<u>Sample no.</u>	<u>Adhesion (g/cm)</u>		<u>Fiber pull (%)</u>	
	<u>(unstretched)</u>	<u>(stretched)</u>	<u>(unstretched)</u>	<u>(stretched)</u>
1	156.4	111.7	97	35
2	156.4	156.4	93	73
3	167.6	167.6	93	97
4	167.6	145.2	97	36
5	212.2	167.6	95	60
6	167.6	178.7	95	87

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Example II

A series of tapes employing an acrylate-based pressure-sensitive adhesive composition was prepared to illustrate adhesion to various surfaces, and fiber pull from the surfaces of various packaging materials. Each tape of the series was prepared by coating one major surface of a 4 mil (0.0102 cm) LLDPE backing with a tackified pressure-sensitive adhesive. The adhesive was an acrylate adhesive comprising 90 parts by weight isooctyl acrylate and 10 parts by weight acrylic acid prepared according to Re. 24,906 (Ulrich), incorporated herein by reference. The backing had been corona treated on both major surfaces thereof. A low-adhesion backsize composition was applied to the major surface of the backing not bearing the adhesive. The low-adhesion backsize composition was of the type described in Example 1. The coating weight of adhesive of each of the unstretched and stretched tapes of the series, in g/m², are set forth in Table 5.

20

Table 5

<u>Sample no.</u>	Coating weight	
	<u>unstretched</u>	<u>stretched</u>
1	0.037	0.013
2	0.060	0.016
3	0.106	0.030
4	0.129	0.027

The data in Table 5 indicate that stretching to ultimate yield can give a 3.7 times reduction (approximately) in adhesive coating weight per unit area. The reduction is believed to result from an increase in the surface area of the backing.

Both adhesion to the surface of corrugated paperboard and fiber pull from the surface of corrugated paperboard are set forth in Table 6.

<u>Sample no.</u>	<u>Table 6</u> Adhesion (g/cm)		Fiber pull (%)	
	<u>(unstretched)</u>	<u>(stretched)</u>	<u>(unstretched)</u>	<u>(stretched)</u>
1	170.9	74.8	98	12
2	173.2	95.0	97	20
3	156.4	147.5	100	44
4	169.8	167.6	199	94

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Both adhesion to the surface of fiberboard and fiber pull from the surface of fiberboard are set forth in Table 7.

Table 7

<u>Sample no.</u>	<u>Adhesion (g/cm)</u>		<u>Fiber pull (%)</u>	
	<u>(unstretched)</u>	<u>(stretched)</u>	<u>(unstretched)</u>	<u>(stretched)</u>
1	164.2	103.9	75	5
2	158.6	153.0	100	100
3	150.8	167.6	100	100
4	164.2	175.4	100	77

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The data in the foregoing tables show that there is a greater decrease in adhesion than would have been expected from a mere reduction in adhesive coating weight. For example, the adhesion and tack of a tape having a stretched coating weight of 2.0 to 2.2 grains per 24 sq. in. [0.020 to 0.022 g/cm²] (i.e., Sample nos. 3 and 4) is significantly lower than the adhesion and tack of a tape having an unstretched coating weight of 2.1 grains per 24 sq. in. [0.021 g/cm²] (i.e., Sample no.1). A decrease in adhesion correlates directly with a reduction in tack, i.e., detackification.

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Example III

A group of containers was unitized by means of the stretchable tape disclosed herein in the manner shown in FIG. 3. The tape was applied by hand at a stretch ratio of 6 to 1. For the purpose of comparison, a second group of containers, identical to the first group, was unitized by means of stretch wrap, also applied by hand. Both groups of unitized containers were subjected to the mechanical handling test and the vibration (table) test. The load displacement for each type of wrapping was similar, and each type of wrapping was deemed to be adequate for use in a manufacturing facility.

The tape and stretch wrap were then removed from the unitized containers, and the scrap tape and scrap wrap were weighed. The stretch wrap weighed 7.4 ounces (1.02 kg). The stretch tape weighed 2.3 ounces (0.32 kg). Thus, the use of tape resulted in a 70% reduction in waste.

Various modifications and alterations of this invention will become apparent to those skilled in the art without departing from the scope and spirit of this invention, and it should be understood that this invention is not to be unduly limited to the illustrative embodiments set forth herein.

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WHAT IS CLAIMED IS:

1. A method of unitizing at least two objects that are arranged in one or more tiers, at least one of said tiers comprising at least one object, said method comprising the steps of:

- (1) providing a stretchable, detackifiable pressure-sensitive adhesive tape having (1) a backing having a Young's modulus of at least about 2,500 psi (176 kg/cm²) but less than about 100,000 psi (7031 kg/cm²), a lengthwise elongation at break of at least about 150% and low recovery, (2) said backing bearing a layer of pressure-sensitive adhesive thereon;
- (2) adhering a first small portion of said tape to a small portion of one of said objects;
- (3) stretching said tape sufficiently to detackify the portion thereof not adhered to said one of said objects;
- (4) wrapping said detackified portions of said tape around at least two of said objects; and
- (5) adhering a second portion of said tape to a small portion of one of said objects, whereby said objects are capable of resisting mechanical handling and vibration of said arranged objects.

2. The method of Claim 1, wherein said objects are arranged in at least two tiers.

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3. The method of Claim 2, wherein said tape is wrapped around all of said objects on at least one of said tiers.

5 4. The method of Claim 1, wherein said objects comprise packages having at least six sides.

5. The method of Claim 1, wherein said tape is wrapped in a direction substantially parallel to the
10 plane formed by the uppermost surfaces of said objects.

6. The method of Claim 1, wherein said tape is wrapped in a direction substantially non-parallel to the plane formed by the uppermost surfaces of said
15 objects.

7. The method of Claim 1, wherein said tape is wrapped in both a direction substantially parallel to the plane formed by the uppermost surfaces of said
20 objects and a direction substantially non-parallel to the plane formed by the uppermost surfaces of said objects.

8. The method of Claim 1, wherein at least
25 one stretched and wrapped portion of said tape crosses over at least another stretched and wrapped portion of said tape.

9. A method of closing and securing a
30 package comprising the steps of:

(1) providing a stretchable,
detackifiable pressure-sensitive
adhesive tape having (i) a backing
having a Young's modulus of at
35 least about 2,500 psi (176 kg/cm²)
but less than about 100,000 psi
(7031 kg/cm²), a lengthwise
elongation at break of at least

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about 150% and low recovery, (2) said backing bearing a layer of pressure-sensitive adhesive thereon;

5

(2) adhering a first small portion of said tape to a small portion of said package;

10

(3) stretching said tape sufficiently to detackify the portion thereof not adhered to said package;

(4) wrapping said detackified portion at least partially around said package; and

15

(5) adhering a second small portion of said tape to a small portion of said package, whereby said package is capable of remaining closed and secured.

20

10. The method of Claim 8, wherein said package has at least six sides.

11. A method of unitizing a plurality of objects comprising the steps of:

25

(1) providing a stretchable, detackifiable pressure-sensitive adhesive tape having (1) a backing having a Young's modulus of at least about 2,500 psi (176 kg/cm²) but less than about 100,000 psi (7031 kg/cm²), a lengthwise elongation at break of at least about 150% and low recovery, (2) said backing having a layer of pressure-sensitive adhesive thereon;

30

35

(2) adhering a first small portion of

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said tape to a small portion of at least one of said objects;

(3) stretching said tape sufficiently to detackify the portion thereof not adhered to said object;

(4) wrapping said detackified portion of said tape around said plurality of said objects; and

(5) adhering a second portion of said tape to a small portion of at least one of said objects, whereby said plurality of said objects is unitized in the form of a bundle.

12. A stretchable, detackifiable

pressure-sensitive adhesive tape having a backing having a Young's modulus of at least about 2,500 psi (176 kg/cm²) but less than about 100,000 psi (7031 kg/cm²), a lengthwise elongation at break of at least about 150% and low recovery (a) said backing having a layer of pressure-sensitive adhesive thereon, said tape having a portion thereof stretched to at least 200% of its original length, whereby said tape detackifies by at least about 10%.

13. The tape of Claim 12, wherein said tape detackifies by at least about 25%.

14. The tape of Claim 12, wherein said tape detackifies by at least about 50%.

15. The tape of Claim 12, wherein said tape has a portion thereof stretched to at least 600% of its original length.

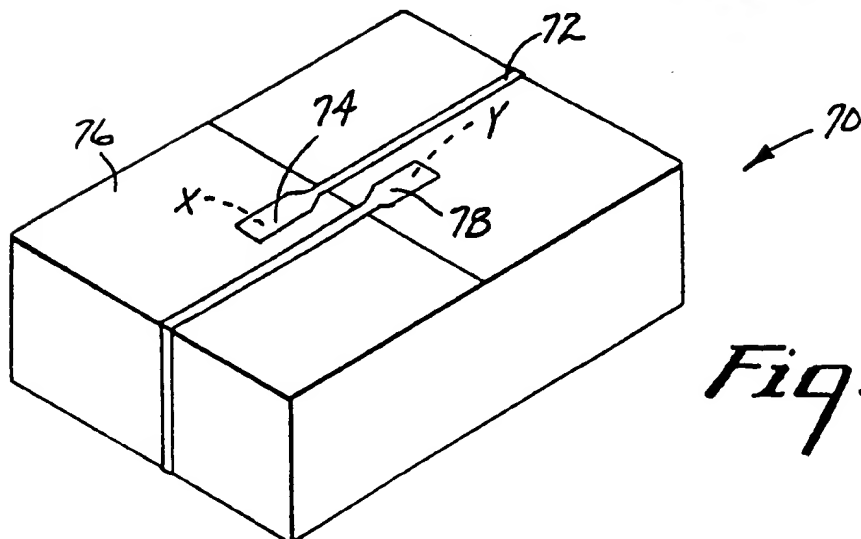
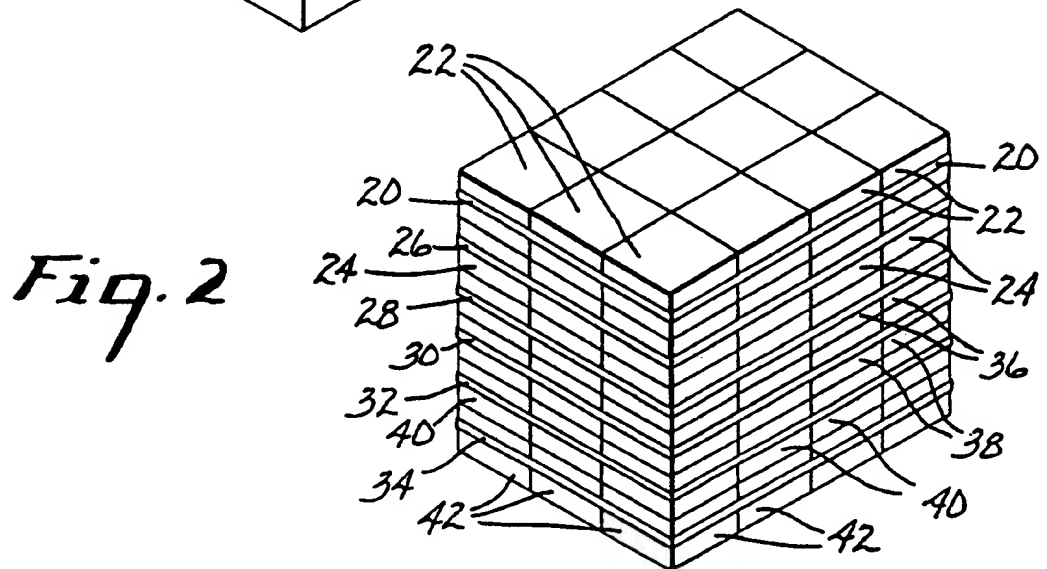
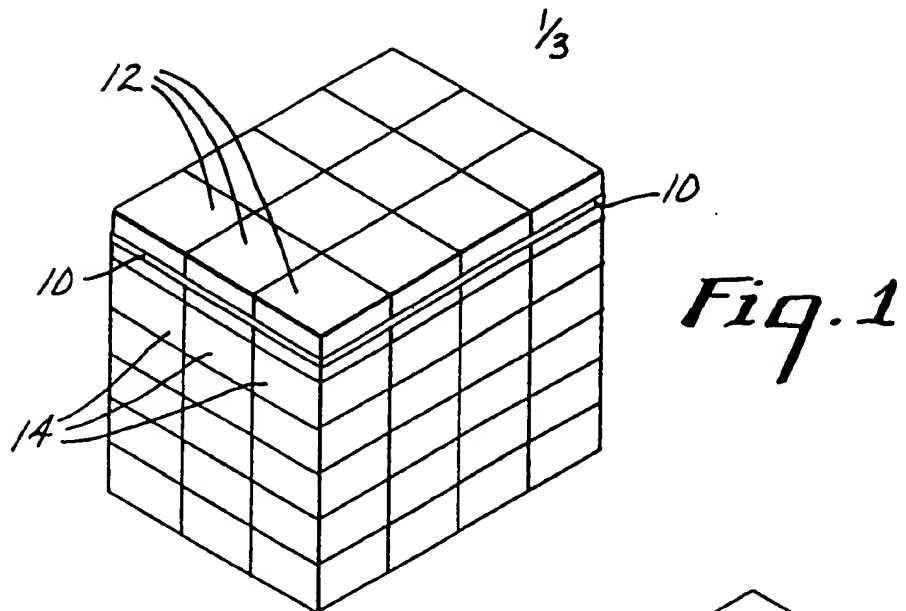


Fig. 3a

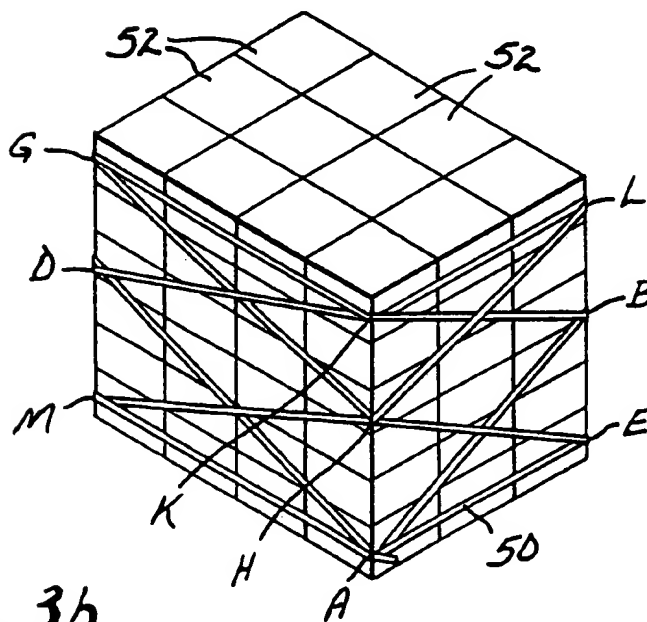
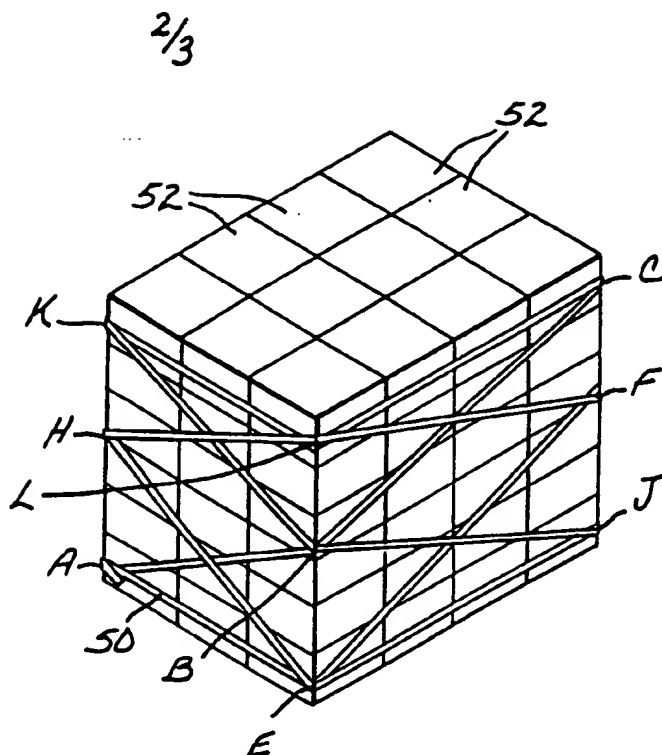
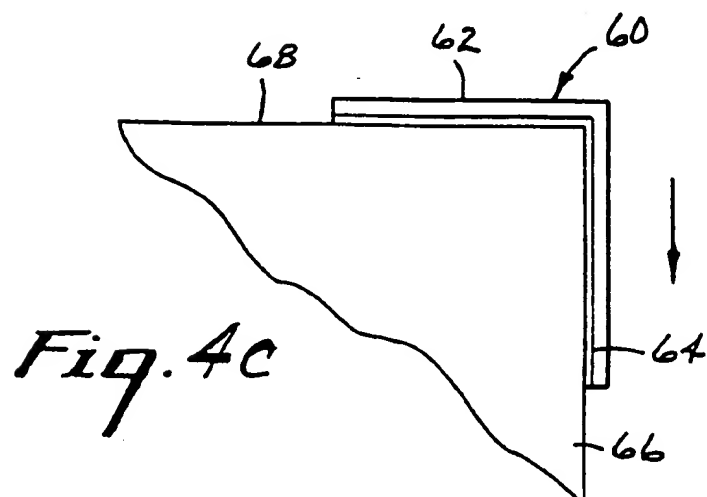
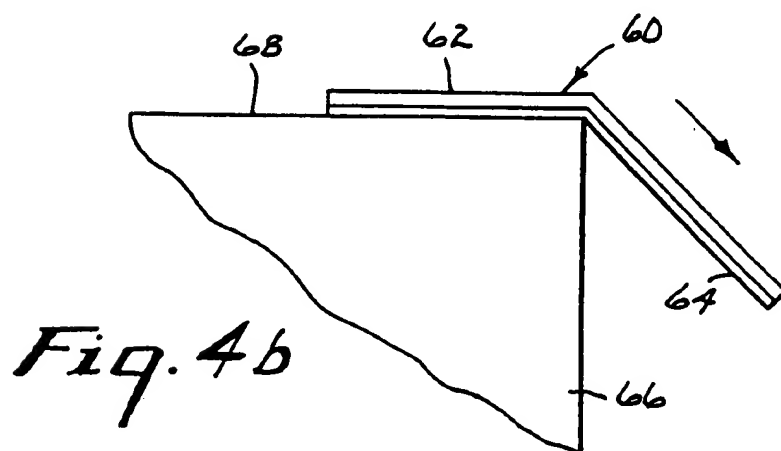
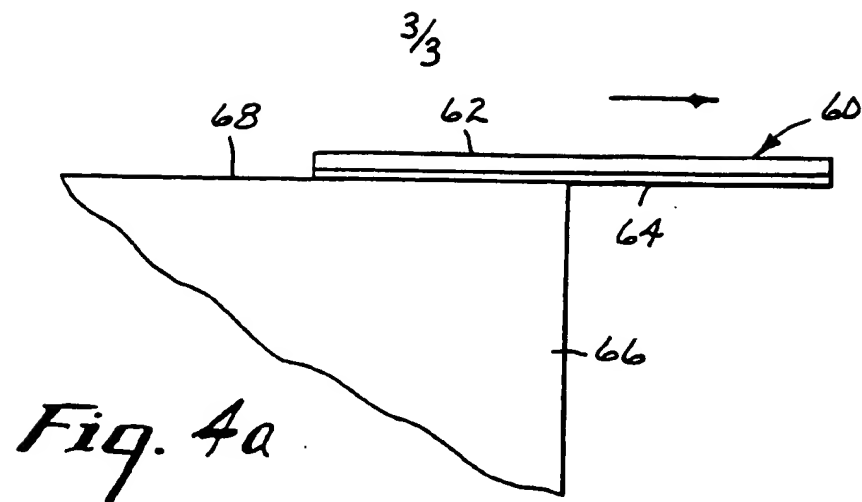



Fig. 3b



INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 92/05128

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 B65B13/02; B65B17/02; B65D71/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B65B ; B65D	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,3 535 189 (J. HALL) 20 October 1970 see column 8, line 66 - column 10, line 39; figures	1,4,9-12
A	US,A,3 239 994 (G. ETZEL) 15 March 1966 see column 1, line 7 - line 36 see column 8, line 12 - column 10, line 42; figures	1,9,11, 12
A	US,A,4 365 710 (E. SWANSON) 28 December 1982 see column 2, line 12 - column 6, line 6; figures	1,9,11
<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"A" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
22 OCTOBER 1992		30. 11. 92
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		JAGUSIAK A.H.G. 

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. US 9205128
SA 61839**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-3535189	20-10-70	None	
US-A-3239994		None	
US-A-4365710	28-12-82	None	

EPO FORM P0079

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82